Automated System for Calculating Thermophysical Properties of Fluids and Thermal Processes of Cryogenic Plants

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An automated system for calculating thermophysical properties of monatomic and diatomic gases, air, carbon dioxide and some hydrocarbons was developed. On the basis of values of properties, calculating thermal processes of cryogenic plants and optimization of corresponding cycles is fulfilled.

The data on properties of fluids can be determined in the single-phase and two-phase regions, and on the saturation and melting lines at temperatures from the triple point to 1500 K and at pressures up to 100 MPa at nine combinations of independent variables. This system allows us to calculate temperature, pressure, density, enthalpy, entropy, isochoric and isobaric specific heat, speed of sound, heat of vaporization, fugacity, viscosity, thermal conductivity, Prandtl number, surface tension and some other properties.

Unified equations of state for gas and liquid are used for calculating thermodynamic properties in wide intervals of density and temperature. Most of them are accurate reference equations. For better reliability in calculating properties, the user can select equations compiled by different authors for the same substance. The dependences of viscosity and thermal conductivity on temperature and density are used for calculating transport properties.

The system allows us to determine parameters of stream in points of input in machines and apparatus and in points of output, and also energy and material balances of processes. The processes of isothermal compression, adiabatic throttling, polytropic expansion, heat exchange in two-stream and multi-stream apparatus, separation of vapor-liquid mixtures in the vessel of a liquid, and many other processes can be calculated.

The complex decisions of such tasks for the certain structure scheme of cryogenic plants makes it possible to determine parameters and basic characteristics of the thermodynamic cycle. The system is effectively used in calculating the processes of cryogenic and chemical plants.